Task 4 - Calculating the Full Economic Costs of Selected Field Management Change Scenarios for Improving Soil Health on Vermont Farms

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The goal of Task 4 is to estimate the full economic costs associated with the field management change scenarios to improve soil health on Vermont farms that were described as part of this project under Task 2. The scenarios are only meant to represent a very small subset of the possible field management changes available to Vermont farmer. They were selected to cover some of the more common types of changes for field crop production (Scenarios 1-3) and for vegetable production (Scenarios 4a-c). **Please see the Task 2 report for more details on the scenarios.**

The calculations and results for Scenarios 1, 2, and 3 are shown in the Excel file named “Task 4 Costs Scenarios 1-3”. For Scenarios 4a, 4b, and 4c, these are shown in the file named “Task 4 Costs Scenarios 4a-c”. This introduction provides an overview of the scenarios and the resulting cost estimates. When the information allowed for it, calculations of the cost per unit of soil health increase is presented, which can give an indication of the cost-effectiveness of the scenario to achieve improvements in soil health. Because the Working Group is focused on the Comprehensive Assessment of Soil Health (CASH), the cost-effectiveness is most useful when the CASH score is available for the baseline and scenario. The cost-effectiveness can also be calculated for other related metrics such as organic matter or aggregate stability, but these need to be interpreted with caution.

NOTE: The spreadsheet files are not intended to be decision support tools in which users can change values in cells to calculate results for other scenarios. In reality, the spreadsheets can be used to do this, but producing a ready-to-use decision support tool requires a level of formatting and instructions that are beyond the scope of this task for this project.

Scenario 1 – Best management practices for corn silage production

This scenario is based on specific research trials conducted by UVM Extension. The business-as-usual (BAU) is continuous corn silage with conventional tillage and no cover cropping. The scenario is the use of no-till and winter rye cover crop. The use of no-till saves the farm $50.50/acre, but the cover crop costs $85/acre to sow the seed and terminate the crop in the spring. There is a reduced yield of 3.3 tons/acre with the BMPs, which imposes an opportunity cost (i.e. foregone profit) of $132/acre. The overall result is a reduced profit of $166.50/acre for the BMP scenario.

The UVM research included scores for the Comprehensive Assessment of Soil Health (CASH), as well as other components such as organic matter and aggregate stability, each of which has been used to show the cost per unit of increase for this scenario. The CASH score increased by 5.40, which results in a cost of almost $31 per point. In a similar fashion, the scenario cost $55.50 for each 0.1% increase in the measured soil organic matter and $15 per 1% in aggregate stability.

Scenario 2 – From continuous corn silage to a rotation of 5-years corn silage and 5-years hay

This scenario is also based on research results from UVM Extension. See Task 2 report for more details. Based on the published crop enterprise budgets used, the profitability of producing hay is almost twice as great as for producing corn silage. However, many dairy farms have their feeding program based on the use of corn silage so this does not imply that dairy farmers should grow hay instead of corn silage. The economic cost of this scenario is difference in the average annual profit between growing corn silage continuously versus growing corn silage for 5 years and hay for 5 years. This difference is estimated to be $159 more profit for the corn-hay rotation.

Scenario 3 – From continuous corn silage to well-managed grazing

This scenario uses the same baseline of continuous corn silage which has an average profit of $230.90 per acre per year. As described in the notes on the Scenario 3 tab, to calculate a comparable profit per acre the annualized costs for pasture establishment are calculated. This includes costs for fencing, water system, seeding, and lanes. The calculation of each of these costs are described in the notes and can be seen in the Pasture tab of the spreadsheet.

Added to the establishment costs are the annual production costs to get total annual costs for pasture. The value of the pasture forage produced is based on the yield, the relative feed quality and the equivalent value per ton of hay on a dry matter basis. The estimated profit of well-managed pasture is $428 per acre per year, which is $197 more than for continuous corn.

Scenario 4a – Vegetable production with a soil building cover crop rotation

As can be seen in the Task 2 report, this scenario is based on research published by Idowu et al. The baseline scenario is a crop rotation consisting of beans, beets, sweet corn, cabbage, and beans. The soil conserving rotation is beans, field corn, clover/vetch cover crop, sweet corn, and beans. The full economic cost is represented by the difference in average annual profit per acre across these two rotations. The baseline results in an average annual profit of $2,191, which is $1,697 greater than the soil-building crop rotation.

The research did not calculate CASH scores (it predated the CASH test), but did indicate an increase in soil organic matter of 0.2 percentage points and aggregate stability of 5.1 percentage points (from 14.4 to 19.5%). This results in a cost of $247 per 0.1 percentage point increase in organic matter and $333 per 1 percentage point increase in aggregate stability.

Scenario 4b- Vegetable production with reduced tillage and cover crops

This scenario is also based on the Idowu et al. research results. The costs associated with the three tillage types are calculated separately from the costs of the two cover crop types; the combined costs for each combination is presented.

The improvement in soil health associated with each of the 9 combinations is not clear from the Idowu et al. paper. If the specific soil health improvements can be gleaned from the paper, the cost-effectiveness calculations for each of the 9 combinations of tillage and cover crops can be easily calculated.

Scenario 4c - Fertility practices in vegetable production

This scenario is based on research results published in Evanylo et al. (2008) from the Piedmont region in Virginia. There is no economic analysis in the paper; we have calculated the cost-effectiveness of fertility program with regard to the yield of corn, which is an indicator of the relative profitability of each treatment. Cost-effectiveness is determined by the cost of nutrients (fertilizer and/or amendments) per ton of corn yield (paper seems to use total biomass, which is fine as a measure of productivity). Using the information given in the paper, the poultry litter (PL) treatment was most cost-effective, followed by low-compost plus fertilizer (LCF), and then just fertlizer (F).

Related to soil health, Table 5 in Evanylo et al. shows results for bulk density, porosity, and water holding capacity. The treatments that showed the best results in these soil health metrics were annual compost (AC), biennial compost (BC), and biennial compost plus fertilizer (BCF). These results can be seen in the table in the spreadsheet titled “Relative change and rank of soil health metrics by treatment”.

The soil health results were combined with the relative profitability results to assess the relative cost-effectiveness of each treatment for improving each soil health metric. These can be seen in the table in the spreadsheet titled “Cost-effectiveness for Soil Health Metrics”. This analysis shows that PL was the most cost-effective for all three soil health metrics, followed by LCF, and F, and BCF.